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REPORT ON MINERALOGICAL AND ORE TREATMENT INVESTIGATIONS OF URANIUM-BEARING SAMPLES FROM CALUMET URANIUM MINES LTD., PONTIAC CO., QUEBEC.

(Our Ref. Nos. 7/56-2A, 7/56-2B and 11/56-6)

by

W. R. Honeywell
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Introduction

This report covers test work carried out on three samples of split diamond drill core received July 5, July 20 and Nov. 8, 1956 from Calumet Uranium Mines Ltd.

Sample 7/56-2A

Eight samples, about 1 1/2 lb each, of split diamond drill core were received July 5, 1956. The Company's representatives, Mr. Tiphane and Mr. Juteau, reported that this material was from what was known as the "higher grade vein" at depth and that each sample represented about five feet of core across the vein, plus some wall rock, the samples being identified as follows:

Sender's mark	Vertical depth
306	115 ft
307	220
308	230
309	270
310	240
311	70
312	120
313	330

Sample 7/56-2B

Nine drill core samples received July 20, 1951, were understood to represent what the company's representatives termed the "lower grade vein" at depth. The samples were identified as follows:

Sender's mark	Vertical depth
315	419 ft
316	625
318	408
322	14.5
323	103
324	262
325	159
326	200
327	225

Sample 11/56-6

To permit some further work on material from depth, the company provided 21 additional split core samples on November 8, 1956. These samples were identified as follows:

Sender's mark	Hole No.	Footage
255	S-79	235-240
356	S-78	435-440
357	S-77	325-330
358	S-76	269-274
359	S-77	410-415
360	S-75	109-114
361	S-75	277-282
362	S-73	307-312
363	S-72	301-306
364	S-71	165-170
365	S-70	240-245
366	S-69	126-131
367	S-69	253-258
368	S-59	415-420
370	S-31	108-113
371	S-29	200-205
372	S-28	142-147
374	S-27	185-190
375	S-26	192-197
376	S-10	175-180
377	S-8	260-265

Sample 11/56-6 also included a number of small pulverized assay samples and coarser assay reject samples, corresponding to some of the drill core samples listed above, but only the split core material was used for test work.

All samples were understood to have been taken from the company's property in Grand Calumet Island, Pontiac Co., Quebec. Work on this property is covered by A. E. C. B. Exploration Permit MX-5/54, issued January 12, 1954.

Analysis

Head samples, cut from these samples after crushing, were assayed chemically and radiometrically for uranium and thorium. Assays for other significant elements were also carried out and these assays are as follows:

Analytical Ref. No. Sample Ref. No.	RC 3295 7/56-2A %	RC 4021 7/56-2B %	RC 6642 11/56-6 %
U_3O_8, chemical	0.18	0.14	0.057
ThO_2, chemical	0.90	0.72	0.23
U_3O_8, secondary *	0.065	0.042	-
Iron	2.72	3.25	-
Sulphur	0.21	0.71	-
Carbonates (as CO_2)	9.57	10.71	10.53
Lead	0.02	0.02	-
U_3O_8, radiometric	0.13	0.08	0.043
U_3O_8, gamma equivalent	0.532	0.450	0.167
U_3O_8, beta equivalent	0.357	0.289	0.113
ThO_2, (radiometric estimation)	0.96	0.90	0.30
Specific gravity of ore	2.70	-	-

* A sample is leached without added oxidizing agent for 30 minutes in a hot 10% solution of Na_2CO_3. The uranium dissolved is taken as an indication of the secondary uranium present.

It will be noticed that the radiometric assays for uranium are lower than the chemical uranium assays for all the samples. When such a high ratio of thorium to uranium is present, as in these samples, radiometric assays should not be relied upon unless confirmed by chemical assays.

In the test work chemical assays were used throughout and the results check fairly well with the chemical head assays. It should perhaps be pointed out that this material is quite spotty or erratic in the concentration of the uranium mineral and therefore accurate sampling and assaying is more difficult than in the case of a more uniform product.

Summary

1. The present samples were diamond drill core samples which were reported to represent material from depth. The samples were submitted to determine whether this material would concentrate in a manner similar to previous samples, which were understood to represent lower grade material occurring closer to the surface (See reports SR - 324/55, SR - 351/56, SR - 399/56 and SR 418/56.)

2. It was determined that the activity in the 7/56-2A and 2B samples was due mainly to uranothorite instead of thorian uraninite. The uranothorite has a specific gravity of 4.18 compared with a specific gravity of 8 to 9 for the thorian uraninite which was the main active mineral in earlier samples. Also the pure uranothorite mineral assayed only 8.42% U_3O_8. The thorium oxide content was 29.9 percent.

3. By superpanning, the highest grade concentrate assayed only 2.38% U_3O_8. This was obtained on sample 7/56-2A.

4. By tabling of sample 7/56-2A, a preconcentrate assaying 0.30% U_3O_8 with a recovery of 61% was obtained in 28.5% of the weight.

5. The table preconcentrate still contained 5.0% CO_2 and if acid leached would consume over 200 lbs of sulphuric acid per ton of preconcentrate.

6. Similar results were obtained with sample 7/56-2B.

7. On sample 11/56-6, assaying 0.057% U_3O_8, a flotation test with the object of floating off the acid consuming carbonates was carried out. Eighty percent of the carbonate was removed with a loss of 5.6 per cent of the uranium. The leachable portion would still contain 3.0% CO_2.

Mineralogy of Sample 11/56-6

Mineralogically, parts of sample 11/56-6 resemble samples 7/56-2A and 7/56-2B (for mineralogy of these samples see Radioactivity Division report SR - 446/56) in which uranothorite appears to be the only radioactive mineral. Other parts resemble an earlier sample 1/55-17 (see Radioactivity Division report SR - 324/55) in which thorian uraninite is the most abundant radioactive mineral. Sample 11/56-6 however is much lower grade than any of these other samples.

In view of the low grade of the sample only a brief mineralogical examination was made of randomly selected pieces of split diamond drill core.

Coarsely crystalline limestone and pegmatite make up the bulk of this sample. Orange to white calcite, pyroxene, and fluorite are the essential constituents of the limestone. Minor amounts of apatite, muscovite, sphene, pyrite, uranothorite, and uraninite are present. The pegmatite is essentially made up of pink feldspars, quartz, and pyroxene with small amounts of fluorite, sphene, biotite, pyrite, and uranothorite. Both the limestone and pegmatite include a few specimens of medium-grained material. Some gneissic rock is also present composed chiefly of feldspar, amphibole and pyroxene with minor sphene, biotite, and pyrite.

Only four of the twenty-four pieces of drill core examined showed appreciable radioactivity. Uranothorite appears to be present in both the limestone and the pegmatite while uraninite was observed only in the limestone The uranothorite occurs in the limestone in the form of long prismatic crystals, brownish-black in colour, and of vitreous lustre on

freshly fractured surfaces. In the pegmatite vitreous dark-brown masses are intergrown with the pyroxene. The prismatic crystals of uranothorite are up to 1 x 3/4 mm in section while the largest mass measured in the pegmatite is 6 mm in diameter. Uraninite was observed only in one specimen of greyish-white limestone where it occurs as small, cubic crystals up to 1/2 mm square. Pyrite forms a rim around a few of the uraninite crystals.

Test Procedure

Sampling

For samples 7/56-2A and 2B, the core was crushed to minus 20 mesh and a head sample was cut from each. The remainder was screened to give plus and minus 65 mesh fractions for laboratory testing.

Sample 11/56-6 consisted of crushed rejects and pulp rejects as well as the split drill core. The split drill core only was used for test work and was combined and crushed to minus 1/4 inch. One-half was then crushed to minus 10 mesh and a head sample cut out for assay.

Concentration Test Work

Samples from the minus 20 plus 65 and minus 65 mesh fractions of samples 7/56-2A and 2B were treated on the superpanner. A larger quantity of these same fractions was also tabled on a laboratory Wilfley table. The results for these tests are given in Tables 1, 2, 3 and 4.

Table 1
Sample 7/56-2 A
Superpanning Results after Crushing to -20 Mesh

Size Fraction Products	Wt % Fraction	Wt % Overall	Chem Assay % U_3O_8	% Dist. U_3O_8 Fraction	% Dist. U_3O_8 Overall
-20 + 65 mesh					
Tip	2.46	1.12	2.38	22.4	13.1
1st Midd	3.69	1.68	1.19	16.8	9.8
2nd Midd	14.87	6.77	0.59	33.6	19.6
Tails	78.98	35.94	0.09	27.2	15.9
Fraction	100.00	45.51	0.26	100.0	58.4
-65 mesh					
Tip	2.02	1.10	2.38	31.0	12.9
1st Midd	2.76	1.50	0.73	13.0	5.4
2nd Midd	5.31	2.89	0.31	10.6	4.4
Tails	70.17	38.24	0.067	30.2	12.6
Fines	19.74	10.76	0.12	15.2	6.3
Fraction	100.00	54.49	0.155	100.0	41.6
Original Ore		100.00	0.20		100.0
		Metallurgical Balance			
-20+65 Tip		1.12	2.38		13.1
" 1st Midd		1.68	1.19		9.8
"2nd Midd		6.77	0.59		19.6
-65 Tip		1.10	2.38		12.9
-65 1st Midd		1.50	0.73		5.4
-65 2nd Midd		2.89	0.31		4.4
Concentrate		15.06	0.88		65.2
-20+65 Tails		35.94	0.09		15.9
-65 Tails		38.24	0.067		12.6
-65 Fines		10.76	0.12		6.3
Tails		84.94	0.083		34.8
Orig. Ore		100.00	0.20		100.0

Table 2

Sample 7/56-2A

Tabling Results after Crushing to -20 Mesh

Size Fraction Products	Wt % Fraction	Wt % Overall	Chem Assay $\%U_3O_8$	% Dist. U_3O_8 Fraction	% Dist. U_3O_8 Overall
-20+65 mesh					
Conc	3.20	1.60	0.85	17.6	9.8
Midds	35.46	17.77	0.24	55.0	30.7
1st Tails	60.57	30.35	0.069	27.0	15.1
2nd Tails	0.77	0.38	0.072	00.4	0.2
Fraction	100.00	50.10	0.154	100.0	55.8
-65 mesh					
Conc	3.44	1.72	1.10	30.8	13.6
Midds	14.99	7.48	0.13	15.8	7.0
Tails	39.16	19.54	0.062	19.7	8.7
Fines	42.41	21.16	0.098	33.7	14.9
Fraction	100.00	49.90	0.123	100.0	44.2
Original Ore		100.00	0.14		100.0
		Metallurgical Balance			
-20+65 Conc		1.60	0.85		9.8
-20+65 Midds		17.77	0.24		30.7
-65 Conc.		1.72	1.10		13.6
-65 Midds		7.48	0.13		7.0
Concentrate		28.57	0.30		61.1
-20+65 1st Tails		30.35	0.069		15.1
-20+65 2nd Tails		0.38	0.072		0.2
-65 Tails		19.54	0.062		8.7
-65 Fines		21.16	0.098		14.9
Tails		71.43	0.076		38.9
Original Ore		100.00	0.14		100.0

Table 3

Sample 7/56-2B

Superpanning Results after Crushing to -20 Mesh

Size Fraction Products	Wt % Fraction	Wt% Overall	Chem Assay %U_3O_8	% Dist. U_3O_8 Fraction	% Dist. U_3O_8 Overall
-20+65 mesh					
Tip	3.48	1.73	0.84	19.4	9.4
1st Midd	7.09	3.53	0.49	23.2	11.1
2nd Midd	15.90	7.92	0.25	26.5	12.8
Tails	73.53	36.62	0.063	30.9	14.9
Fraction	100.00	49.80	0.15	100.0	48.2
-65 mesh					
Tip	3.57	1.79	2.20	49.1	25.4
1st Midd	3.57	1.79	0.76	16.9	8.8
2nd Midd	11.24	5.64	0.13	9.1	4.7
Tails	68.52	34.40	0.033	14.2	7.4
Fines	13.10	6.58	0.13	10.7	5.5
Fraction	100.00	50.20	0.16	100.0	51.8
Original Ore		100.00	0.155		100.0
		Metallurgical Balance			
-20+65 Tip		1.73	0.84		9.4
-20+65 1st Midd		3.53	0.49		11.1
-20+65 2nd Midd		7.92	0.25		12.8
-65 Tip		1.79	2.20		25.4
-65 1st Midd		1.79	0.76		8.8
-65 2nd Midd		5.64	0.13		4.7
Concentrate		22.40	0.50		72.2
-20+65 Tail		36.62	0.063		14.9
-65 Tails		34.40	0.033		7.4
-65 Fines		6.58	0.13		5.5
Tails		77.60	0.056		27.8
Original Ore		100.00	0.155		100.0

Table 4

Sample 7/56-2B

Tabling Results after Crushing to -20 Mesh

Size Fraction Products	Wt % Fraction	Wt % Overall	Chem Assay $\%U_3O_8$	% Dist. U_3O_8 Fraction	% Dist. U_3O_8 Overall
-20+65 mesh					
Conc	4.24	2.13	0.43	15.3	7.2
Midds	42.64	21.41	0.18	63.9	30.0
1st Tails	52.94	26.57	0.047	20.8	9.7
2nd Tails	0.18	0.09	0.030	0.0	0.0
Fraction	100.00	50.20	0.120	100.0	46.9
-65 mesh					
Conc	3.15	1.57	1.45	33.5	17.8
Midds	22.49	11.20	0.17	27.9	14.8
Tails	52.88	26.33	0.055	21.3	11.3
Fines	21.48	10.70	0.11	17.3	9.2
Fraction	100.00	49.80	0.137	100.0	53.1
Original Ore		100.00	0.13		100.0

Metallurgical Balance

-20+65 Conc	2.13	0.43	7.2
-20+65 Midds	21.41	0.18	30.0
-65 Conc	1.57	1.45	17.8
-65 Midds	11.20	0.17	14.8
Concentrate	36.31	0.25	69.8
-20+65 1st Tails	26.57	0.047	9.7
-20+65 2nd Tails	0.09	0.030	0.0
-65 Tails	26.33	0.055	11.3
-65 Fines	10.70	0.11	9.2
Tails	63.69	0.061	30.2
Orig. Sample	100.00	0.13	100.0

From Table 1, it will be noted that the highest grade concentrate produced by the superpanner assayed 2.38% U_3O_8. It should also be appreciated that it is not possible to separate any 10% grade uranium concentrate from this material, as the pure mineral assayed only 8.42% U_3O_8.

By tabling sample 7/56-2A, a recovery of 61.1% of the uranium was obtained but the calculated grade was only 0.30% U_3O_8 in 28.5% of the weight. By tabling sample 7/56-2B, a recovery of 69.8% of the uranium was obtained at a grade of 0.25% U_3O_8 in 36.3% of the weight.

The table preconcentrate of sample 7/56-2A contained 0.30% U_3O_8, 2.18% ThO_2 and 5.05% CO_2. If a preconcentrate containing 5.0% CO_2 were subjected to an acid leach, over 200 lbs of sulphuric acid would be required per ton of preconcentrate, due to the carbonate content.

Calcination

It was discovered, with a previous uranium ore sample, that by calcining the material at 900°C for several hours (5 hours has been used) and then superpanning, a better grade and recovery of the uranium was obtained.

A minus 65 mesh sample of the 7/56-2A material was treated in this manner with the following results:

Products	Wt %	Chem U_3O_8 %	% Dist. U_3O_8
Tip	2.53	4.34	56.4
1st Midds	3.54	0.37	6.8
2nd Midds	8.08	0.15	6.2
Tails	74.49	0.08	30.6
CO_2 Loss	11.36		-
Orig. Ore	100.00	0.19	100.0

If these results are compared with the results in Table 1, it will be seen that a better grade and recovery was obtained by calcining. A marketable grade was not obtained, however, and the cost of such a process would be quite high; probably in the order of nine to ten dollars per ton ore calcined.

Flotation

Elimination of the carbonates by flotation was considered as a possible solution and accordingly a new sample, Ref. No. 11/56-6, was submitted for this work.

The uranium content of this sample was quite low (0.057% U_3O_8), or less than half the previous samples.

One flotation test was carried out on this material. The ore was ground to 80% minus 200 mesh and reagents used were 1 lb Na_2CO_3/ton to bring the pH up to 9.5 and a total of 0.6 lb double distilled oleic acid/ton as a frother and collector. The temperature of the pulp was about 30°C and the float products were cleaned twice with the following results.

Flotation Test

Products	Wt %	Chem. Assay % U_3O_8	% Dist. U_3O_8	% CO_2	% Dist. CO_2
Cleaner Float	32.03	0.009	5.6	26.97	80.7
2nd Cl. Tails	6.71	0.057	7.4	14.64	9.2
1st Cl. Tails	12.41	0.074	17.8	6.28	7.3
Rougher Tails	48.85	0.073	69.2	0.62	2.8
Orig. Ore	100.00	0.052	100.0	10.70	100.0

It will be seen that 80.7% of the carbonate was removed with a loss of 5.6% of the uranium. However, the leachable portion would only assay

0.072% U_3O_8 and would still contain 3.0% CO_2. This portion would therefore probably consume at least 135 lb of sulphuric acid per ton of leach feed.

The cost of the flotation reagent per ton ore would probably be as follows:

Na_2CO_3 at 1 lb/ton = 3 cents f. o. b. plant
Double distilled oleic acid = 18 x 0.6 = 11 cents f. o. b. plant

In addition to the above there would be the cost of freight, labor and amortization of plant.

Conclusion

It was found that the present samples, which were understood to represent ore at depth, did not respond to gravity concentration in the same way at all as previous samples which were understood to represent material outcropping at the surface.

Possible treatment methods previously investigated here for recovery of uranium and thorium from the near-surface type of material, would therefore not apply to the material occurring at depth.

On the basis of the additional material received representing the ore at depth, it does not appear that the grade and characteristics would permit economic treatment.

Accounts of work by the Mines Branch on samples from this property appear in the following Radioactivity Division reports:

	On samples understood to represent near-surface material	On samples understood to represent material at depth
Mineralogy	SR - 324/55	SR - 446/56
Concentration	SR - 351/55 SR - 399/56	SR - 461/56
Chemical processing of concentrates	SR - 418/56 (SR-351/55)	

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